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Effects of Probiotic Supplementation on Growth And Body Conformation of Goat Kids Raised Under Different Management Systems

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An experiment was carried out at the Department of Livestock Management, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University Tandojam to compare the growth, body conformation and economics of non-descriptive male goat kids under different management systems. Twelve kids, approximately 6 months of age, were divided into two groups (6 replicates per group). The group A kids were raised in a semi-intensive management system, allowed to graze and fed with a concentrate ration mixed with commercially available probiotics. In contrast, kids in group B were subjected to an intensive management system restricted to graze, fed with a concentrated ration mixed with probiotics and green forage at the animal shed. The total duration of the experiment was eight weeks and the observations on the growth and conformation features (girth, height and length) were recorded every week. The results revealed that the average final body weight of group A kids was (15.45 kg) significantly ($P<0.05$) higher than that of kids in group B (13.86 kg). In addition, the body conformation i.e. girth, height and length (61.33 cm, 53.66 cm and 44.5 cm, respectively) of kids in group A were also observed significantly higher ($P< 0.05$) as compared to the kids of group B (58.83 cm, 52 cm and 43.33 cm, respectively). Furthermore, comparing the economic aspects of kids of experimental groups, it was observed that group A earned more net profit (2338 rupees/kid) than group B (1491 rupees/kid). In conclusion, significantly better growth performance, improved body conformation traits and higher profitability were recorded in goat kids raised under the semi-intensive management system supplemented with a probiotic. These findings suggest that semi-intensive management can be a more profitable and sustainable practice for rearing goat kids.

Keywords: Livestock management, probiotic supplementation, growth performance, economics, semi-intensive system, intensive system.

INTRODUCTION

The livestock is an essential element of the agriculture sector as it provides a source of milk, meat, hide, skin and draught power for agricultural operations and industrial raw materials. Among small ruminants, goats hold the most important economic and biological niche in rural communities of developing countries. They are the most valuable source of family income, especially for the rural communities involved in agricultural practices (Oluwatayo and Oluwatayo, 2010). The goat (Capra hircus) was the first ruminant domesticated between 7,000 to 9,000 B.C., which is considered a "poor man's cow". Their ability to survive under diverse management systems (semi-intensive and intensive farming) makes them a preferred livestock choice, especially in resource-limited settings. They play a fundamental role in the rural economy of small, marginal landless farmers of the country and can be beneficially raised with small investments under semi-intensive and intensive management systems. They give rise to a rapid return because of their short generation intervals, higher prolificacy rate and the ease of selling the associated products. The management of kids from the very beginning has a direct influence on their growth performance because later on these kids will be raised for the production of meat and milk. The main problem in raising kids after weaning is associated with a lower rate of growth

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and it is mainly due to their deprived management (Sen *et al.*, 2004; Panhwar, 2007). The intensive system is characterized by high intake and high performance and is generally practiced for high-potential animals. It is associated with high investments in housing, veterinary care, food resources, labor and other infrastructure, etc. In semi-extensive production systems, goats can graze for 5 to 8 hours in pastures and supplementary needs are met through ration supplements (Yadav *et al.*, 2016). Probiotics are "biologically favorable" agents such as (Bacillus spp) when introduced into the cultural environment they fight pathogenic microorganisms and promote the growth performance of the organisms in addition they are non-toxic and non-pathogenic microorganisms without adverse effects and improve rumen function when administered to the organisms (Ding *et al.*, 2008; Salini *et al.*, 2013). It has also been reported that probiotics have a positive effect on the gut microflora, it improve the nutrient utilization in the rumen, thereby increasing the daily weight gain in ruminants. It is a well-known fact that the benefits of goat enterprise are related directly to the weight gain and feeding conversion efficiency of growing animals, which ultimately affects the growth of goat kids. However, the absence of a scientific or economic approach is often a major limitation to the success of goat farming (Kishore *et al.*, 2014; Pinar *et al.*, 2014). Therefore, evaluating management practices that involve probiotic supplementation can provide insights regarding the improvement of productivity and profitability. Keeping in view the above facts, it was hypothesized that goat kids raised under a semi-intensive system supplemented with probiotics will exhibit superior growth performance, body conformation and economic profitability compared to those in an intensive system. Therefore, the present study was designed to evaluate the performance of non-descriptive male goat kids under semi-intensive and intensive management systems fed with probiotic supplemented ration.

MATERIALS AND METHODS

***Experimental animals and their management*:** The research work was performed at the Livestock Experimental Station, Department of Livestock Management, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University Tandojam. Twelve non-descriptive male goat kids having the same age of about 6 months were preferred due to their rapid growth phase, economic relevance and uniformity for reliable comparisons for the experimental work. At the start of the experiment, each kid was given a different recognition number using aluminum-made tags and was treated for external as well as internal parasites by using Ivermectin and Albendazole drugs. The kids were allowed for an adaptation period of ten days in a confined and well-ventilated animal shed before the start of experimental feeding. They were quite healthy without any sign of clinical ailment or external injury.

***Experimental procedure*:** The male goat kids were placed in two separate pens with six kids in each pen. Goat kids were housed in a group pen (3.0 m × 2.0 m) with wooden slatted floors. They were grouped as group A; comprising six non-descriptive male goat kids having tag numbers NDK1, NDK2, NDK3, NDK4, NDK5 and NDK6 were reared under a semi-intensive system (Table 1). They were allowed to graze and fed concentrate ration containing (Wheat bran, barley, maize grain, pulses and cotton seed cake) mixed with commercially available probiotic supplements (Table 2) at the rate of 2.5 gm/day/kid at the animal shed.

Table 1. Experimental design of goat kids raised under different management systems.

Group	No.	Age	Sex	System of housing	Feeding management
A	6	Six months	Male	Semi-intensive management System	Feeding concentrate ration mixed with probiotic supplements at the animal shed and allowed for grazing.
B	6	Six months	Male	Intensive management system	Feeding concentrate ration mixed with probiotic supplements and green fodder at the animal shed (i.e., no grazing).

Table 2. Initial body weight, girth, height and length.

	Tag No:	Body weight (Kg)	Body girth (cm)	Body height (cm)	Body length (cm)
Group: A	NDK 1	11.40	57	47	39
	NDK 2	10.00	53	45	39
	NDK 3	10.90	55	46	39
	NDK 4	11.20	55	48	40
	NDK 5	11.00	56	46	38
	NDK 6	10.50	54	46	39
	Mean	10.83	55	46	39
Group: B	NDK 7	09.80	53	45	38
	NDK 8	10.50	54	48	39
	NDK 9	12.00	57	46	40
	NDK 10	09.60	53	45	37
	NDK 11	10.50	54	46	39
	NDK 12	10.40	53	46	39
	Mean	10.46	54	46	38.67

The kids were grazed for 8 hours from 9 am to 5 pm at the field surroundings of the Department of Livestock Management Sindh Agriculture University Tandojam. During grazing the experimental kids fed barseem residues and a variety of herbs and shrubs. The water was provided ad libitum. The experiment was conducted for eight weeks. While group B; Comprising six non-descriptive male goat

kids having tag numbers NDK7, NDK8, NDK9, NDK10, NDK11 and NDK12, was kept intensively at a livestock experimental station (Table 1). The kids were restricted from grazing and fed concentrate ration mixed with probiotic supplements (Table 2) at the rate of 2.5 gm/day/kid and green fodder (barseem) at the animal shed. They were provided ad libitum green fodder and water.

During the experiment following parameters were recorded

***Initial body weight and Body conformation (height, length and girth)*:** The initial body weight (kg) of kids was recorded after an adaptation period of 10 days by a weighing machine (Yameto, China), present at Livestock Experimental Station.

***Weekly body weight*:** Weekly body weight (kg) was recorded in the morning before feeding.

***Final body weight*:** The final body weight (kg) was observed at the end of the experiment.

***Body conformation (height, length and girth)*:** Body conformation was measured using a measuring tape in centimeters weekly following Banait *et al.* (2002).

a. Body height was measured from withers to the end of the hoof.
b. Length was measured from shoulder point to pin bone.
c. Girth was taken just behind the elbow as the circumference of the chest.

***Economics*:** For economic assessment, the initial purchasing price of kids, feeding cost, medicines, labor and miscellaneous charges were recorded. Moreover, at the end, the profit and loss margin was compared among both groups of kids.

***Statistical analysis*:** The analysis of variance for the obtained data was performed using a statistical analysis system (Statistix 8.1) to assess significant differences between the two groups. The significance level was set at $p< 0.05$.

RESULTS AND DISCUSSION

***Average body weight*:** The average body weight of non-descriptive male goat kids was noted for eight weeks and the results (Table 3) indicate that the group A kids managed under a semi-intensive management system demonstrated better growth performance as compared to group B kids reared under an intensive management system. It was noticed in the current study that the non-descriptive goat kids of group A obtained significantly ($P<0.05$) higher final body weight (15.45 kg) in compression than the kids of group B raised under an intensive management system (13.90 kg). The results further showed that under a semi-intensive management system only grazing was offered to goat kids in addition to concentrates mixed with probiotic supplemented ration, but the growth of kids was remarkably higher under a semi-intensive management system this is because welfare under a natural environment during grazing. Another reason for the difference in the weight gain among both groups of kids is that under a semi-intensive system the body conditions of kids improved due to exercise during open grazing as compared to the intensively managed kids. A previous study was conducted by Huma *et al.* (2018) and suggested that grazing shows a positive impact on body growth and conformation characteristics, probably grazing fulfilled the freedom needs of animals and welfare parameters of kids and hence more internal and external body development was observed under semi-intensive management system as compared to intensive management. Similarly, Herrera *et al.* (2011) also reported that under a semi-intensive system, kids grow faster than in an intensive system. This is because in a semi-intensive system kids go to the pasture daily they gain more energy than kids under confinement. Furthermore, Bohrey and Jain (2004) found that the body weight of kids under a semi-intensive system of management was significantly higher as compared to the other systems. The high gains in the semi-intensive system might be attributed to a higher intake of nutrients compared to the intensive systems. The results of the present findings are supported by Esfiokhi *et al.* (2024). They reported that probiotic supplements increase the performance of crossbred goat kids through the improvement of body weight and metabolism. Similarly, Antunovic *et al.* (2005) reported that probiotic feeding enhanced the average body weight and daily gain in lambs.

Table 3. Average body weight (Kg) of non-descriptive goat kids reared under two management systems fed with probiotic supplemented ration.

Weeks	Group A	Group B	Per week difference
1	11.32	10.65	0.67
2	11.80	11.05	0.75
3	12.40	11.50	0.90
4	13.00	12.00	1.00
5	13.65	12.43	1.22
6	14.20	12.90	1.30
7	14.70	13.40	1.30
8	15.45	13.90	1.55
	Groups	Weeks	
S.E	0.1039	0.2078	
p-value	0.0005	0.0005	

***Body Conformation (Girth, height and length)*:** The average body girth of non-descriptive male goat kids was noted for eight weeks and the results (Table 4) indicate that body girth was significantly higher in group A (61.33 cm) compared to group B (58.83 cm). The above result indicated that kids of semi-intensive management system group A obtained superior body girth as compared to the kids of intensive management system group B.

Body height of non-descriptive male goat kids of both groups was measured for eight weeks & results are demonstrated in Table 5. After subsequent completion of 8 weeks, the body height was significantly greater in group A, i.e. recorded as (53.7 cm) than in group B (52 cm) respectively. The results

indicated that goat kids of semi-intensive management system group A had higher body height than kids of intensive management system group B. Comparative results also revealed that the difference in body height affected by the management system were statistically significant (P<0.05)

Table 4. Average body girth (cm) of non-descriptive goat kids reared under two management systems fed with probiotic supplemented ration.

Weeks	Group A	Group B	Per week difference
1	55.66	54.50	1.16
2	56.50	54.83	1.67
3	57.33	55.66	1.67
4	58.33	56.33	2.00
5	59.16	57.16	2.00
6	59.66	57.50	2.16
7	60.50	58.33	2.17
8	61.33	58.83	2.50
	Groups	Weeks	
S.E.	0.1741	0.3483	
p-value	0.0005	0.0005	

Table 5. Average body height (cm) of non-descriptive goat kids reared under two management systems fed with probiotic supplemented ration.

Weeks	Group A	Group B	Per week difference
1	47.0	46.5	0.50
2	48.2	47.3	0.83
3	49.0	48.0	1.00
4	49.7	48.3	1.37
5	50.5	49.7	0.80
6	51.7	50.8	0.87
7	52.5	51.3	1.17
8	53.7	52.0	1.70
	Groups	Weeks	
S.E.	0.1834	0.3668	
p-value	0.0001	0.0001	

Weekly data for body length of non-descriptive male goat kids of both groups were recorded and the results are demonstrated in Table 6. After the completion of the experiment, the average body length of kids in semi-intensive management system was recorded as 44.5 cm, compared to 43.33 maintained under an intensive management system.

The body conformation (girth, height, length) of the non-descriptive male kids in present study for the kids reared under semi-intensive system group A was higher (61.33 cm, 53.7 cm, and 44.5 cm) as compared with the goat kids of group B raised in an intensive system (58.83 cm, 52 cm, and 43.33 cm) respectively. Thus the present findings are to the findings of Kochewad *et al.* (2009) they reported that all growth parameters viz. chest girth, body length and body height of osmanabadi kids in the supplemented group with probiotics were higher as compared to the control group. A possible explanation for this could be that kids during active growth are more benefited by probiotic supplementation and observed gain in height, girth and length of kids due to probiotic supplementation. Similar results have been reported by Jayabal *et al.* (2008) they reported that final body length, body height, heart girth, and paunch girth parameters were significantly (P<0.05) higher in the probiotic supplementation group than a control group in the non-descript kids. The possible reason for improved growth performance with the addition of probiotics may be that, during the post-weaning period, kids are transferring from a milk diet provided by the dam to a forage or grain-based diet which stimulates rumen development. Likewise, Bohrey and Jain (2004) found that under a semi-intensive system, the body height and length were significantly higher (P<0.01) followed by an intensive management system. The variation was mainly due to the feed supplementation that provides more amounts of nutrients under a semi-intensive management system the kids were able to move with freedom, while this welfare atmosphere was not available for them in the respective system. Hence their growth and conformation improved under a semi-intensive management system.

Table 6. Average body length (cm) of non-descriptive goat kids reared under two management systems fed with probiotic supplemented ration.

Weeks	Group A	Group B	Per week difference
1	39.67	38.83	0.84
2	40.16	39.83	0.33
3	40.83	40	0.83
4	41.83	40.83	1.00
5	42.33	41.33	1.00
6	43.16	42.16	1.00
7	43.50	42.67	0.83
8	44.5	43.33	1.17
	Groups	Weeks	
S.E.	0.1238	0.2476	
p-value	0.0005	0.0005	

***Economics*:** After completing eight eight-week experimental trials, the economic aspects of the project were analyzed. Each kid in group A received 250 g of concentrated ration mixed with commercially available probiotic supplements (2.5g /day/kid) and left open for grazing for 8 hours per day, while every kid in group B received 250 grams of concentration with probiotic supplements at a rate of (2.5/day/kid) and 2kg of green fodder per day. By accumulating total spending costs comprising the estimated initial price of the kids, the total costs were Rs.9662 and Rs.9709 for kids of groups A and B, respectively. The estimated average sale prices for kids in group A were 12,000 rupees and 11,200 rupees for kids in group B. After deducting the total expenditures from the total sale value of the kid, the net benefit from each kid in group A was 2338 rupees and the

net benefit of each kid in group B was 1491 rupees. It was concluded that the goat kids raised in a semi-intensive management system with probiotic supplements at the animal shed and green forage during grazing yielded greater net profit than the kids kept in an intensive system. The following results show similarity with the results of Bacchu *et al.* (2015), who reported higher economic returns among the probiotic-supplemented group as compared to a control group. The result shows further similarity with Paramasivam *et al.* (2002) who reported that for rearing of Barbari goats, the semi-intensive system is more beneficial than other systems. Similarly, it is also reported by Legesse *et al.* (2005) that higher profit margin was obtained with goats in a semi-intensive system of management. The results show similarity with Patel *et al.* (2009) who found that the highest net returns per goat/year were obtained in goats under semi-intensive system and lower return per goat/year for intensive system. Furthermore, Thiruvenkadan *et al.* (2007) documented that the net profit obtained per animal under semi-intensive group was Rs.360.30 while Rs.266.90 for those reared under intensive management system respectively. It seems that animals under a semi-intensive system had effectively utilized both the provision of the supplement and the ability to selectively graze on the available forage.

Table 7. Economics of non-descriptive goat kids reared under two management systems.

Sr.	Particulars	Groups	
		A	B
1	Per animal feed consumption (kg)	124.14	126.14
2	Concentrate (kg/per animal)	14	14
3	Rate of concentrate (Rs/kg)	50	50
4	Amount of concentrate (Rs) 2 x 3	700	700
5	Probiotic supplements (gm/per animal)	140	140
6	Rate of probiotic supplements (Rs/2.5 gm/per animal)	7.5	7.5
7	Amount of probiotic supplements in 8 weeks (Rs) 5 x 6	1050	1050
8	Quantity of green fodder (kg/animal) 1 – 2	56	112
9	Rate of green fodder (Rs/kg)	7	7
10	Amount of green fodder (Rs/animal) 8 x 9	392	784
11	Total feed cost/animal (Rs) 4 + 7+ 1	2142	2534
12	Cost on medication/vaccination (Rs)	120	175
13	Labour cost (Rs)	700	300
14	Misc. cost (Rs)	200	200
15	Estimated initial cost of kids (Rs/kid)	6500	6500
16	Total Costs (Rs)	9662	9709
17	Weight gain/kid in 8 weeks (kg)	4.62	3.44
18	Initial weight/kid (kg)	10.83	10.46
19	Total weight (kg/kid)	15.45	13.90
20	Estimated selling price of animal (Rs/kid)	12000	11200
21	Net profit (Estimated selling price of animal – Total Costs)	2338	1491

***Conclusion*:** Based on the findings of this study, it is concluded that body weight was higher in non-described goat kids raised under semi-intensive management systems fed a diet enriched with probiotic supplements. Additionally, the semi-intensive system showed a better conformation of the body (girth, height and length) and produced a significantly higher net benefit. These findings highlight the advantages of integrating grazing with probiotic supplementation in goat farming. Future research should be conducted to explore the long-term impacts of probiotic supplementation on immunity, reproductive performance and meat quality in goats.

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***Conflict of interest*:** No conflict of interest to declare

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***Ethical statement*:** All procedures were approved by the Institutional Ethical Committee of Sindh Agriculture University, Tandojam, following ethical research guidelines.

***Availability of data and material*:** The experimental data and materials used in this study are currently stored in the corresponding author's repository and will be made available upon reasonable request.

***Code availability*:** Not applicable**.**

***Consent to participate*:** Not applicable**.**

***Consent for publication*:** Not applicable**.**

SDGs addressed: *1. Poverty, 2. Zero Hunger,3. SDG 8: Decent Work and Economic Growth,4. SDG 12: Responsible Consumption and Production.*

***Policy referred*:** 1. National Livestock Policy (Pakistan),2. Agriculture and Rural Development Policies,3. Sustainable Development Policy Frameworks, 4. Pro-Poor Livestock Development Policies.

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REFERENCES

Antunovic, Z., M. Speranda, B. Liker, V. Seric, D. Sencic, M. Domacinovic and T. Speranda. 2005. Influence of

feeding the probiotic Pioneer PDFM® to growing lambs on performances and blood composition. Acta Veterinaria 55:287-300.

Bacchu, Z., S.C. Jingar, S. Navab, K. Ajesh and H.L. Bugaliya. 2015. Effect of dietary supplementation of probiotics on juvenile growth and economics of goat production. Journal of Bio Innovation 4:44-48.

Banait, H.B., S.Z. Ali and and Kuralkar. 2002. Variation in body conformation traits in different breeds of goats. Indian Veterinary Journal 79:591-594.

Bohrey, A. and P. Jain. 2004. Management system effect on the growth of goat kids. Indian. Journal of Animal Sciences 74:893-895.

Ding, J., Z. Zhou, L. Ren and Q. Meng. 2008. Effect of Monensin and live yeast supplementation on growth performance, nutrient digestibility, carcass characteristics and ruminal fermentation parameters in lambs fed steam flaked corn-based diets. Asian-Australasian Journal of Animal Sciences 21:547-554.

Esfiokhi, S.M., M.A. Norouzian, M.S. Abadi and M.R. Ahvanooei. 2024. Effects of probiotic-supplemented milk replacer on growth, blood biochemistry, fermentation, digestibility, and carcass traits in lambs. Veterinary and Animal Science 25:100368.

Herrera, P., J. Bermejo, A. Henríquez, M. Vallejo and R. Costa. 2011. Effects of extensive system versus semi-intensive and intensive systems on growth and carcass quality of dairy kids. Revista Brasileira de Zootecnia 40:2613-2620.

Huma, R., A. Mansoor, A. Shahzad, A. Suhail, B. Haroon and B. Attique. 2018. Study on growth and carcass weight of male Dumbi lambs under two management systems. Journal of Entomology and Zoology Studies 7:1299-1304.

Jayabal, T., R. Murllidharan, G. Tensingh and M. Murugan. 2008. Growth performance of stall-fed goats under probiotic supplementation. Indian Journal of Veterinary and Animal Sciences Research 4:179-184.

Kishore, K., J. Ramana, D. Kumar, A. Ravi, E. Rao and P. Prasad. 2014. Effect of complete feed or grazing with supplementation on growth and carcass characteristics in Nellore ram lambs. Journal of Animal Research 4:19-22.

Kochewad, S., J. Chahande, A. Kanduri, D. Deshmukh, S. Ali and V. Patil. 2009. Effect of probiotic supplementation on growth parameters of osmanabadi kids. Veterinary World 2:29-30.

Legesse, G., G. Abebe and K. Ergano. 2005. The economics of goats managed under different feeding systems. Livestock Resources for Rural Development 17:1-7.

Oluwatayo, I. and T. Oluwatayo. 2010. Small ruminants as a source of financial security. A case study of women in rural southwest Nigeria. Institute for Money, Technology and Financial Inclusion (IMTFI), Working Paper 2012:1-21.

Panhwar, F. 2007. Goat farming in Sindh Pakistan. Agriculture research service, United States Department of Agriculture 1:1-8.

Paramasivam, A., S. Arunachalam, T. Sivakumar and V. Ramesh. 2002. Growth performance and carcass traits of Barbari goats under different systems of management. Indian Journal of Animal Sciences 72:1016-1018.

Patel, A., B. Mathur, P. Rohilla, U. Rani and N. Patil. 2009. Comparative analysis of different management systems in arid goat breeds. Indian Journal of Animal Sciences 79:514-518.

Pinar, T., O. Gokhan, R. Cennet, B. Tugba and Y. İbrahim. 2014. Effect of Minosel tablet on blood parameters of goat kids raised under poor maintenance and nutrition. Journal of Animal Resources 4:167-173.

Salini, M., A. Thomas and J. Anand. 2013. Alterations in the microbial load at certain non-specific immune sites of Macrobrachium rosenbergii supplemented with Centella asiatica. The Bioscan 8:701-704.

Sahoo, B., T. Tiwari, P. Kumar, B.C. Mondal, D.V. Singh and Y.P. Joshi. 2012. Effect of probiotic supplementation on growth performance and blood biochemicals in crossbred calves. The Indian Journal of Animal Sciences, 82(3).

Sen, A., A. Santra and S. Karim. 2004. Carcass yield, composition and meat quality attributes of sheep and goat under semiarid conditions. Journal of Meat Science 66:757-763.

Thiruvenkadan, A., K. Karunanithi, J. Muralidharan and K. Senthilvel. 2007. Growth rate and economics of rearing kids with different levels of concentrates feeding. Journal of Veterinary of Animal Science 3:89-94.

Yadav, S., A. Singh and S. Yajuvendra. 2016. Training program on advances in sheep and goat production and management Duvasu Mathura, India June 26-30.